Occasional Paper No. 11 November 30, 1940

UNITED STATES DEPARTMENT OF AGRICULTURE

NORTHEASTERN FOREST EXPERIMENT STATION[1]

C. Edward Behre, Director

New Haven, Connecticut

ROOTING WHITE PINE CUTTINGS

Albert G. Snow, Jr.
Assistant Plant Physiologist

[1] Maintained in New Haven, Connecticut, in cooperation with Yale University.

ROOTING WHITE PINE CUTTINGS

Greenwood cuttings of white pine (Pinus strobus L.) can be rooted in outdoor propagating beds according to the results of experiments started in the summer of 1939 at the Hopkins Memorial Experimental Forest, Williamstown, Massachusetts. The desirability of propagating white pine vegetatively has been emphasized repeatedly, particularly in reference to multiplying individuals thought to be resistant to white pine blister rust.1/ This species has long been considered a difficult subject to propagate vegetatively, and the results of the present experiments have indicated a number of the important factors concerned. These factors may be listed briefly as (1) the age of the tree from which cuttings are taken; (2) position on the tree from which cuttings are taken; (3) influence of auxin treatments; (4) method of handling in the propagating bed; (5) individual variation; (6) presence of fungi; and (7) length of time required for rooting.

EXPERIMENTAL PROCEDURE

Four-inch greenwood cuttings were collected from different positions on trees of various ages the latter part of July and early August (1939), and treated with indolebutyric acid (IB) solutions and dusts containing IB and naphthaleneacetic acids in agricultural clay in proportions of 1:2000 and 1:10,000. After chemical treatment replicate sets of 20 cuttings were planted in two types of beds, namely, a "sash bed" covered at night by glass and containing partially rotted horse manure and bedding straw under a 6-inch layer of a 3:2 sand-peat mixture, and the open type of bed covered with burlap shade frames only and containing an 8-inch layer of the same sand-peat mixture as above. No rooting had occurred at the time of a preliminary examination in November of the same year. The cuttings were mulched with hay over winter and kept in the beds a second season; the examination forming the basis for this report was made on October 15-17, 1940. The significance of results as presented in the discussion is based on a statistical analysis of the data according to the method of Fisher.2/

1/ Schreiner, E. J. The possibilities of the clone in forestry. Jour. For., 37(1):61-62. 1939.

2/ Fisher, R. A. Statistical methods for research workers. 7th ed. p. 128. 1938.

RESULTS AND DISCUSSION

The results of the various experiments summarized in Tables 1 to 4 inclusive show that the average percent of white pine cuttings rooting ranges from 0 to 55 percent, depending on a number of factors that have a marked influence on rooting of this species.

Age of tree.--One of the most important factors that influences the rooting of white pine cuttings is the age of the trees from which they are taken. In the tests summarized in Table 1 it is evident that the younger age classes respond much more readily to treatment.

Table 1. Percent rooting of cuttings from trees of various ages*

Age in years	5	10	15	20	40
Block I	65	0	15	0	0
Block II	45	0	25	0	0
Average	55	0	20	0	0

*All cuttings given uniform treatment with indolebutyric acid at a concentration of 25 mg./l.; collected and treated July 17, 1939, and examined for rooting October 16, 1940.

In this experiment no cuttings from trees older than 15 years were successfully rooted; also all of those from 10-year-old trees died before any rooting had occurred. The fact that no older trees were propagated under these circumstances does not preclude the possibility that the negative results could have been due in part to individual variation and to carliness of collection. Only 3 trees in the 20-year age class and 1 tree in the 40-year-old class were sampled in this experiment. Cuttings from older trees have been rooted to a limited extent in previous experiments at this station, and there is evidence to show that cuttings collected at the right time of year from 60-year-old trees will root quite well.3/ The fact that in this experiment no cuttings from 10-year-old trees rooted may be due in part to a possible difference in the inherent rooting capacity of individual trees. Cuttings collected from 10-year-old trees from an entirely different locality several weeks later (Table 3) rooted very well, and it is questionable whether time of collection was entirely responsible for this wide difference.

3/ Deuber, C. G. Vegetative propagation of conifers. Trans., Conn. Acad. A. & Sci., Vol. 34 (in press).

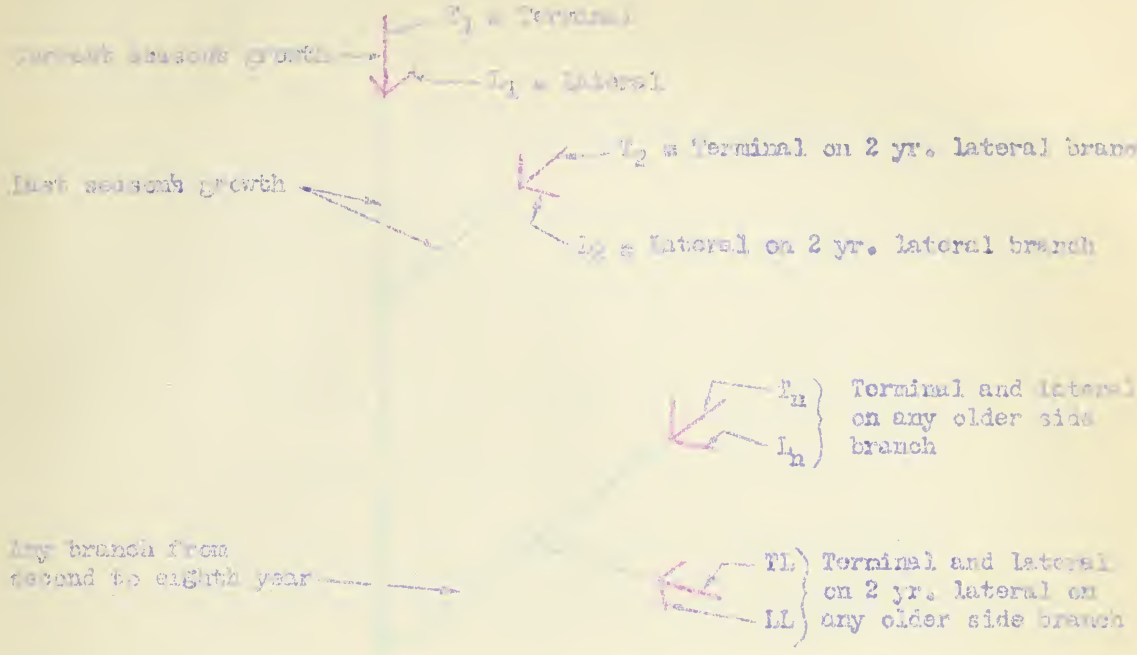

Figure 1.--Diagrammatic illustration of the position on a ten year old white pine tree from which cuttings of current seasons growth (indicated in red) are taken.

Position on tree.--The position on the tree from which cuttings are taken (Fig. 1) has a considerable influence on the amount of rooting obtained. Table 2 summarizes the results of an experiment in which tests of the position-effect were made.

Table 2. Percent rooting of cuttings from different positions on the tree*

Cutting types	L_1	T_2	L_2	T_n	L_n	TL	LL
Block I	0	0	5	0	0	15	30
Block II	0	0	15	0	15	5	20
Average	0	0	10	0	7.5	10	25

*All cuttings from 10-yr.-old trees given a uniform 6-hr. treatment with indolebutyric acid at a concentration of 25 mg./l.; collected and treated July 27, 1939, and examined for rooting October 16, 1940. (See Fig. 1 for explanation of cutting types.)

The rooting response of the various cutting types may be segregated into three categories, namely, those not rooting (L_1, T_2, and T_n), those rooting on an average of 7.5 to 10 percent (L_2, L_n, and TL), and the type rooting on an average of 25 percent (LL). The differences between these categories were statistically significant.

This experiment shows that cuttings of the current season's growth taken from a position farthest removed from the terminal, i. e., lateral on a lateral (LL), may be expected to root more readily than those from a position either lateral to the terminal growth on a side branch, terminal on a side branch, or a lateral nearest the terminal on the top of a 10-yr.-old tree. This is of practical importance because there are more potential cuttings of this type (LL) on a white pine tree than any other type. This position-effect is probably the underlying relationship involved in reports3/ 4/ that, in general, cuttings from the lower part of the tree root more readily than those from the upper part of the tree. These differences in rooting exhibited by cuttings of the various types may be due in part to a differential distribution of natural root-inducing auxins correlated with possible electrical potential or nutrient relationships.

Auxin treatments and method of handling.--The influence of various auxin treatments and method of handling are summarized in Tables 3 and 4 for well mixed samples of all types of cuttings collected August 4 from 10-yr.-old trees.

4/ Doran, W. L., R. P. Holdsworth, and A. D. Rhodes. Propagation of white pine by cuttings. Jour. For., 38:823. 1940.

Table 3. Percent rooting of white pine cuttings given various auxin treatments*

Type of bed		Controls		Auxin treatment (concentration of IB in mg./l.)					
		Tap water only	Dust only	Solution only			Solution and dust		
				5	10	25	5	10	25
Sash bed	Block I	25	45	25	20	30	40	35	35
	Block II	45	40	30	25	35	25	35	60
	Means**	35.0	42.5	27.5	22.5	32.5	32.5	35.0	47.5
Open bed	Block I	15	15	30	15	25	10	20	10
	Block II	25	15	15	50	20	5	10	35
	Means**	20.0	15	22.5	32.5	22.5	7.5	15.0	22.5

*Standard deviation = ±10.819
**General mean for sash bed = 34.2; for open bed = 19.7

Table 4. Significance of the difference between means in Table 3

		Difference between means						
		SASH BED						
Treatment		B	C	D	E	F	G	H
TW only	(A)	7.5	12.5*	2.5	7.5	2.5	0.0	12.5*
IB 5 mg./l.	(B)		5.0	5.0	15.0**	5.0	7.5	20.0**
IB 10 mg./l.	(C)			10.0	20.0**	10.0	12.5*	25.0**
IB 25 mg./l.	(D)				10.0	0.0	2.5	15.0**
Dust only	(E)					10.0	7.5	5.0
D + IB 5 mg./l.	(F)						2.5	15.0**
D + IB 10 mg./l.	(G)							12.5*
D + IB 25 mg./l.	(H)							--
		OPEN BED						
Treatment		B	C	D	E	F	G	H
TW only	(A)	2.5	12.5*	2.5	5.0	12.5*	5.0	2.5
IB 5 mg./l.	(B)		10.0	0.0	7.5	15.0*	7.5	0.0
IB 10 mg./l.	(C)			10.0	17.5**	25.0**	17.5**	10.0
IB 25 mg./l.	(D)				7.5	15.0*	7.5	0.0
Dust only	(E)					7.5	0.0	7.5
D + IB 5 mg./l.	(F)						7.5	15.0*
D + IB 10 mg./l.	(G)							7.5
D + IB 25 mg./l.	(H)							--

*Difference between means significant (5 percent level)
**Difference between means highly significant (1 percent level)

The effectiveness of applied auxins in increasing the percentage of cuttings rooting in these experiments was influenced considerably by the type of bed in which they were grown. This was particularly noticeable in the open bed where supplementary auxin-dust treatments actually caused less rooting than when the cuttings were treated with solutions alone. Solution treatments only in the sash bed were no better than the tap water controls, while in the open bed IB at 10 mg./l. gave significantly higher results. The highest average percentage rooting obtained (47.5) was in those groups (sash bed) given dust treatments after being immersed in an IB solution at a concentration of 25 mg./l. This treatment, while not significantly greater than dust treatments alone where an average of 42.5 percent of the cuttings rooted, was significantly better than the tap water controls. Rooting was generally better in the sash bed than in the usual open bed, due in part to the moderating influence of the glass sash and the presence of partially decomposed material underneath the rooting medium. This substratum was permeated with fungi which may be a factor in rooting.

Other factors.--The possibility of individual variation, which has been suggested previously, is a potentially significant factor in the rooting of white pine cuttings that should be given emphasis in future propagation work with this species. The lack of information on proper procedures in white pine propagation has limited studies of this nature in the past. White pine may be as variable as red maple5/ in which knowledge of optimum propagation techniques6/ has made it possible to determine the extent of variation in inherent rooting ability in the species.

Under outdoor conditions white pine cuttings do not appear to root as quickly as when propagated in the greenhouse. Experiments with greenwood cuttings taken from early June to early August and grown in outdoor beds indicate that they will not root in one season, but must be carried over the winter and into the following summer before root initiation takes place. Even though a longer time is required under outdoor conditions, it is believed that this is a more practical method, for the forester interested in the low cost production of stock from cuttings, than growing the material in the greenhouse.

In nearly all cases where white pine cuttings have rooted in past experiments at this station, the rooting media, previously used for white pine cuttings and containing numerous partially decomposed needles, were infected with several species of fungi. Doran et al.4/ also mentioned that their rooting medium had previously been used for coniferous material. Though no direct experimental proof is available, it is suspected that the presence of fungi may be beneficial in the propagation of white pine from cuttings, either by acting as a supplementary source for natural auxins or in a symbiotic relationship. This has been suggested previously in connection with the superior results obtained in the sash bed.

5/ Snow, A. G., Jr. Clonal variation in rooting response of red maple cuttings. Northeastern For. Exp. Sta. Technical Note No. 29. October 23, 1939.

6/ _____. Variables affecting the vegetative propagation of red and sugar maple. Jour. Forestry (in press).

SUMMARY

The results of these experiments have indicated that a number of factors influence the rooting of greenwood cuttings of white pine collected in late summer and grown in outdoor propagating beds.

1. Cuttings from trees in the younger age classes (less than 15 years old) root more readily than those from older trees.

2. In tests involving seven different cutting types from 10-yr.-old trees the greatest rooting response was obtained with those farthest removed from the terminal, i. e., the lateral segments of current season's growth on lateral branches in the lower portion of the tree.

3. Maximum average rooting (47.5 percent) was obtained with a 6-hour treatment of indolebutyric acid at a concentration of 25 mg./l., followed by dipping in auxin dust before planting in an outdoor sash bed.

4. More cuttings rooted in the propagating bed covered with sash at night and containing decomposed horse manure and bedding straw beneath the 6-inch 3:2 sand-peat mixture for a propagating medium than in the usual open type of bed covered with burlap and containing only the sand-peat mixture mentioned above.

5. The experiments indicated that cuttings from individual white pine trees may show considerable inherent clonal variation in rooting ability.

6. It is suggested that fungi may be beneficial in the rooting of white pine cuttings by acting both as a source for additional auxins and in a symbiotic relationship.

7. Greenwood cuttings grown in outdoor propagating beds at Williamstown, Massachusetts, must be carried over the winter and into the following summer before roots are developed.